This presentation should not be considered a final statement of NIOSH policy or of any agency or individual who was involved. This information is intended for use in advancing knowledge needed to protect workers. Comments regarding this presentation may be submitted to the NIOSH Docket Office.

NIOSH/NPPTL Public meeting to Discuss Escape Respirator Standards Development Efforts Used for Respiratory Protection Against Chemical, Biological, Radiological, and Nuclear Agents and Quality Assurance for Certification (CBRN)

Hilton Garden Inn

Canonsburg, PA

June 25, 2003

CDC Workplace Safety and Health

NIOSH

Welcome

Mr. Richard Metzler,

Director, National Personal Protective Technology Laboratory, NIOSH

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Senate Appropriations Committee Language - FY 2001

National Laboratory for Personal Protective Equipment

It has been brought to the Committee's attention the need for design, testing and state-of-the-art equipment for this nation's . . . miners, firefighters, healthcare, agricultural and industrial workers. . . (*Also*) the Committee encourages NIOSH *to carry out research, testing and related activities aimed at protecting workers, who respond to public health needs in the event of a terrorist incident.* The Committee encourages CDC to organize and implement a national personal protective equipment laboratory. . ..

Senate Rpt.106-293 - DEPARTMENTS OF LABOR, HEALTH AND HUMAN SERVICES, AND EDUCATION AND RELATED AGENCIES APPROPRIATION BILL, 2001 FILED, UNDER AUTHORITY OF THE ORDER OF THE SENATE OF JANUARY 6, 1999

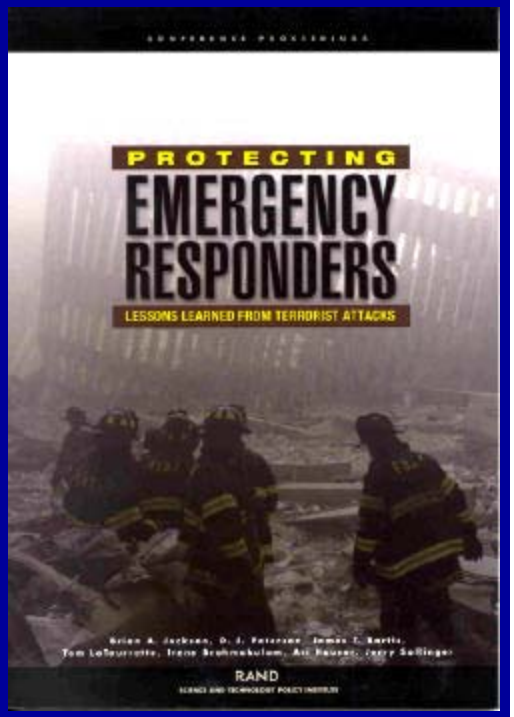
CBRN Standards Development

- **Workshops/Committee Meetings**
  - NIOSH-DOD-OSHA Chemical-Biological Respiratory Workshop & Report (March 1999)
  - Interagency Board Standards & PPE Committees
- **Early Efforts**
  - Understanding emergency responder protection needs
  - Building partnerships
- **Emergency responder protection needs**
  - Firefighter self-contained breathing apparatus urgently needed
  - APRs (gas masks) also needed for warm zone

CBRN Standards Development

Emergency responder PPE needs

- Firefighter self-contained breathing apparatus urgently needed
- APRs (gas masks) also needed for warm zone
- National Science Foundation/ RAND
  - NYC public meeting – Dec 10-11, 2001
  - Critical missions analysis
  - Structural collapse PPE guidelines



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CBRN Standards Development

- Cooperation with NIST, SBCCOM, OSHA, NIOSH, and NFPA
- Define Collaboration for CBRN Standards Development
- IAA's with NIST and SBCCOM
- Initial and Continuing Funding from NIST-NIJ/CDC
- SBCCOM Technical Support for Testing

Purpose of this Public Meeting

- Present Concepts for CBRN Air-Purifying and Self-Contained Escape Respirators Standards
- Present Status of Quality Assurance Module

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NFPA

CUM SCIENTIA DEFENDIMUS

OSHA

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CBRN Standards Development

- SCBA– December 2001

- Gas Masks – March 2003

- Escape sets (APR) – October 2003

- PAPRs – March 2004
- Other Respirators – 2004, 2005

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Agenda – June 25, 2003

Time	Topic	Presenter
9:00 – 9:10	Welcome	R. Metzler, NIOSH
9:10 – 9:30	CBRN Escape Respirator Overview	L. Boord, NIOSH
9:30 – 10:15	General CBRN APR Escape Respirator Requirements	L. Boord, M. Bergman, J. Szalajda,F. Palya: NIOSH
10:15 – 10:30	Break	
10:30 – 11:30	General CBRN APR Escape Respirator Requirements	L. Boord, M. Bergman, J. Szalajda, F. Palya: NIOSH

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Agenda – June 25, 2003

Time	Topic	Presenter
11:30 – 12:00	Comment Period	
12:00 – 1:00	Lunch break	
1:00 – 2:00	CBRN Self Contained Escape Respirator Requirements	L. Boord, M.Bergman, J. Szalajda, F. Palya: NIOSH R. Lins: SBCCOM
2:00 – 2:30	Comment Period	
2:30 – 2:45	Break	
2:45 – 3:45	QA Module Background and Concept	R. BerryAnn, R. Stein, D. Book NIOSH
3:45 – 4:15	Comment Period	
4:15 – 4:30	Wrap-up and Adjourn	

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Meeting Logistics

- **Sign In Sheets**
- **Meeting Recorded, Transcribed for Docket**
- **Presentation in accordance with the Agenda**
- **Q & A Period After Presentations**
  - **Who/Organization/Comment at Microphone**
  - **Address Meeting, Add to Agenda**

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Information Docket
CBRN Escape Respirator

- **Mail:**
  - **NIOSH Docket Office**
  - **Robert A. Taft Laboratories, M/S C 34**
    - **Escape – NIOSH 002**
    - **QA Module – NIOSH 001**
  - **4676 Columbia Parkway**
  - **Cincinnati, OH 45226**

- **Email: niocindocket@cdc.gov**

- **Fax: (513) 533-8285**

- **Phone: (513) 533-8303**

- **NPPTL Web Site: http://www.cdc.gov/niosh/npptl**

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CBRN Escape Respirator Strategy

- CBRN Escape Respirator Concept Goal:
  - Develop a NIOSH standard for escape only respirators that addresses CBRN materials identified as inhalation hazards from possible terrorist events for use by the general working population.

CBRN Escape Respirator Strategy

- Hazard Analysis-Complex Problem
- Intended Escape from Where and What
  - Hot Zone- High Concentrations
  - Warm Zone- Low Concentrations
- Wide Variation in Hazard/Threat
- Multiple Escape Activities

CBRN Escape Respirator Strategy

- Escape From Terrorism Events Complex problem
  - Hazard/Threat Analysis
    - Site Specific
  - Escape Strategy:
    - Exit Immediately
    - Progress to Designated Area
  - Threat & Escape Strategy
    - Impact on Escape Respirator Required

CBRN Escape Respirator Strategy

- Three Categories of Protection
  - High Category
  - Specific Category
  - General Category

CBRN Escape Respirator Strategy

- High Category
  - Unknown Hazards
  - Oxygen Deficiency
- Specific Category
  - Multi Hazard Protection
  - CWA Capability
  - Specific TIM's from General Category
- General Category
  - Multi Hazard Protection
  - CWA Capability

CBRN Escape Respirator Concept

Category	Hazard Description	Respirator Performance
HIGH	CWA & TIM Hazard High Concentrations and/or O_2 Deficiency	Self-Contained Respirator
SPECIFIC	CWA & TIM Hazard Plus Specific TIM's Adequate O_2	Air Purifying Respirator
GENERAL	CWA & TIM Hazard Adequate O_2	Air Purifying Respirator

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CBRN Escape Respirator Overview

- CBRN Escape Respirator Concept Paper
- Part 1:
  - CBRN Air Purifying Escape Respirator
- Part 2:
  - CBRN Self-Contained Escape Respirator

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CBRN Escape Respirator Overview

- Part 1: CBRN Air Purifying Escape Respirator
  - Section 1: Goal Statement
  - Section 2: Hazard Categories
  - Section 3: Respirator Use
  - Section 4: Gas Life Tests
  - Section 5: Environment
  - Section 6: Performance Requirements
  - Section 7: Design
  - Section 8: 42 CFR Applicable Sections
  - Section 9: Service & Maintenance
  - Section 10: Training
  - Section 11: Cautions and Limitations
  - Section 12: Quality Assurance

CBRN Escape Respirator Overview

- Part 2: CBRN Self-Contained Escape Respirator
  - Section 1: General
  - Section 2: Requirements
  - Section 3: 42 CFR Approval
  - Section 4: Enhanced Escape Respirator Performance Requirements
  - Section 5: CBRN Requirements

CBRN Air – Purifying Escape Respirator

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CBRN Air-Purifying Escape Respirator – Hazard Analysis and Selection

Initial vulnerability assessment list of chemical agent hazards identified potential respiratory hazards

- **Classification of hazards into Agent Families**
- **Test Representative Agent (TRA) required for each family of agents.**
- **Back up data with other agents within family being generated.**
- **Biological and Radiological agents are addressed as particulates requiring P-100 media**

Testing of the TRA should provide protection for respirable Chemical agents (110), plus Particulate Biological agents (13) & Particulate Radiological/Nuclear agents (16):

61 Organic Vapor Family, with vapor pressures less than that of Cyclohexane (TRA)

32 Acid Gas Family, TRA's = Cyanogen Chloride, Phosgene, Hydrogen Cyanide, Hydrogen Sulfide, and Sulfur Dioxide

4 Base Gas Family, TRA = Ammonia

5 Nitrogen Oxide Family, TRA = Nitrogen Dioxide

4 Hydride Family, TRA = Phosphine

1 Formaldehyde Family, only member of family and is TRC

32 Particulate Family, TRA = DOP

CBRN Air-Purifying Escape Respirator

Test Duration:

- **15, 30, 45, or 60 minutes as specified by the applicant**

Gas Life:

- **25±5°C; 25±5% and 80±5% relative humidity; 64 lpm flow rate**

Panic Demand:

- **Each escape respirator shall provide a minimum service life of 5 minutes when tested at a flow rate of 100±10 liters per minute, 50±5 percent relative humidity and 25±5 °C for each TRA**

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CBRN Air-Purifying Escape Respirator – Multi Gas/Vapor/Particulate Requirements - GENERAL Category Concepts

	Test Challenge	Breakthrough
Ammonia	1250	150
Cyanogen Chloride	150	2
Cyclohexane	1300	10
Formaldehyde	250	10
Hydrogen Cyanide	470	10 (sum of HCN + C2N2)
Hydrogen Sulfide	500	30
Nitrogen Dioxide	100	1 ppm NO_2
Phosgene	125	1.25
Phosphine	150	0.5
Sulfur Dioxide	750	5

CBRN Air-Purifying Escape Respirator – Multi Gas/Vapor/Particulate Requirements - SPECIFIC Category Concepts

	Test Challenge	Breakthrough
Ammonia	2500	150
Cyanogen Chloride	600	2
Cyclohexane	2600	10
Formaldehyde	500	10
Hydrogen Cyanide	940	10 (sum of HCN + C2N2)
Hydrogen Sulfide	1000	30
Nitrogen Dioxide	200	1 ppm NO_2
Phosgene	250	1.25
Phosphine	300	0.5
Sulfur Dioxide	1500	5

CBRN Air-Purifying Escape Respirator Concepts – Benchmark Testing

- Gas Capacity (Service Time)
- CBRN 10 Test Agents

Inadequate Capacity:

ammonia, nitrogen dioxide

Adequate Capacity

cyclohexane, sulfur dioxide, formaldehyde, hydrogen sulfide, cyanogen chloride, phosphine, phosgene, hydrogen cyanide.

CBRN Escape Respirator

CBRN APR Escape CWA Concept

- Sarin (GB):
  - **Vapor Challenge - 210 mg/m^3**
  - **Breakthrough – 0.087 mg/m^3 Peak**
    - 2.1 mg – min/m^3 Ct
  - **Time Agent Applied = Respirator Tested Service Time**
  - **Total Test Time = 2 X Respirator Tested Service Time**

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CBRN Escape Respirator

CBRN APR Escape CWA Concept

- Mustard (HD):
  - **Vapor Challenge 50 mg/m^3**
  - **Liquid Challenge 0.46 ml**
  - **Breakthrough – 0.60 mg/m^3 Peak**
    - 6.0 mg – min/m^3 Ct
  - **Time Agent Applied = Respirator Tested Service Time**
  - **Total Test Time = 2 X Respirator Tested Service Time**

CBRN Air-Purifying Escape Respirator Concepts – Benchmark Testing

	Manufacturer's Model	Challenge Concentration	End Point Concentration	Manufacturer A		
Flow/Humidity				64/25	64/80	100/50
Cyclohexane	C6H12	1300	10	37.6	26.9	21.1
	C6H12	2600	10	19.5	15.1	11.1
Sulfur Dioxide	SO2	750	5	29.9	38.9	18.4
	SO2	1500	5	17.3	20.5	8.9
Ammonia	NH3	1250	12.5	2.4	2.6	1.4
Formaldehyde	CH20	250	1	22	17.7	6.7
	CH20	500	1	17.4	11.1	5.2
Hydrogen Sulfide	H2S	500	5	120	120.0	77.8
Cyanogen Chloride	CK	150	2	120	120.0	86.5
Phosphine	PH3	150	0.3	120	120.0	108.7
Phosgene	COC12	125	1.25	120	120.0	120
Nitrogen Dioxide	NO2	100	25/1*	11.3	37.0	7.8
Hydrogen Cyanide	HCN	470	5**	120	120	81.9

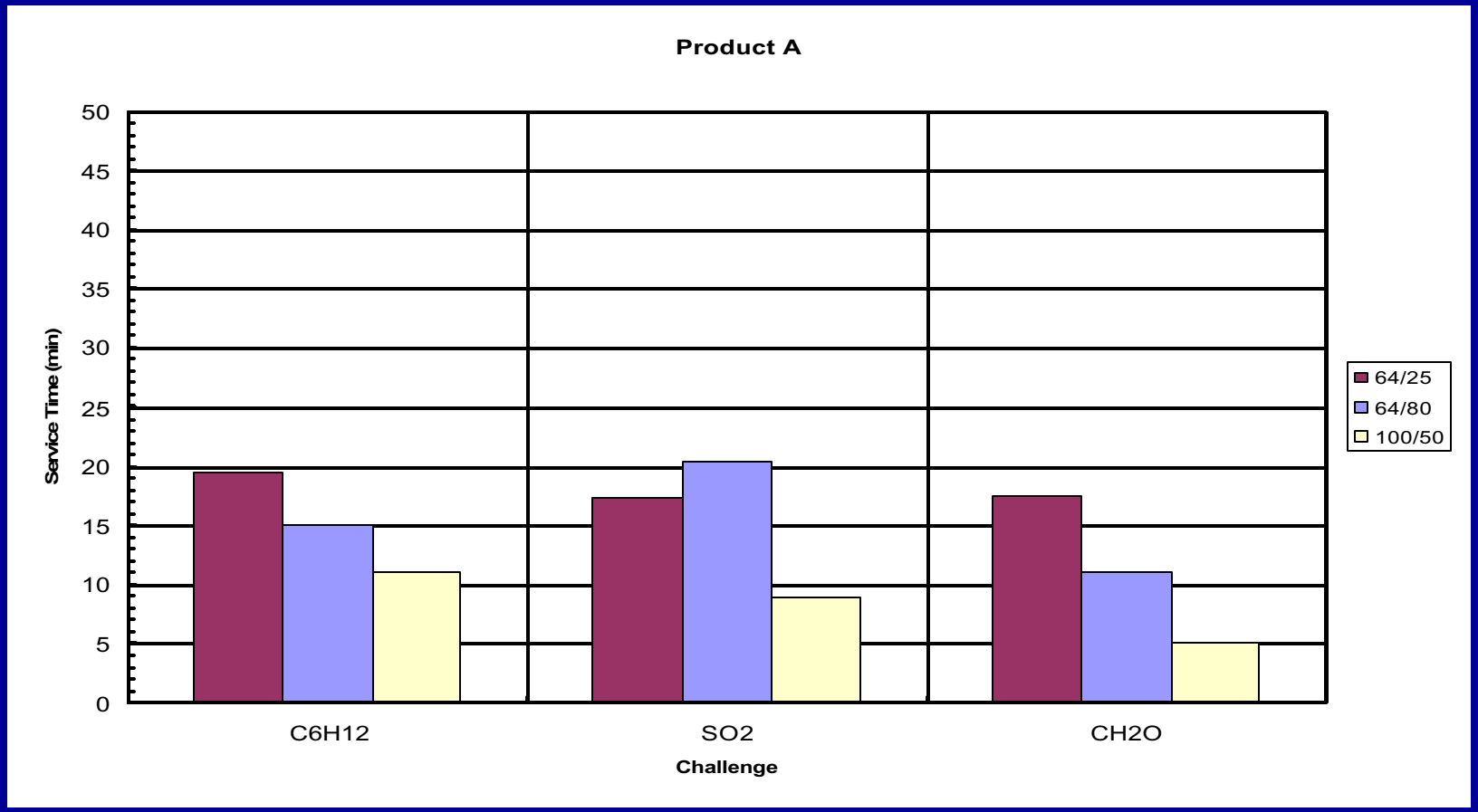
CBRN Air-Purifying Escape Respirator Concepts – Benchmark Testing

	Manufacturer's Model	Challenge Concentration	End Point Concentration	Manufacturer B		
Flow/Humidity				64/25	64/80	100/50
Cyclohexane	C6H12	1300	10	66.9	56.1	42.8
	C6H12	2600	10	51.4	29.5	21.3
Sulfur Dioxide	SO2	750	5	25.9	82.8	38
	SO2	1500	5	8	37.1	16.6
Ammonia	NH3	1250	12.5	48.9	8.3	4.5
Formaldehyde	CH2O	250	1	40	47	21.8
	CH2O	500	1	120.0	37.8	16.3
Hydrogen Sulfide	H2S	500	5	120.0	120	120.0
Cyanogen Chloride	CK	150	2	120.0	120	120.0
Phosphine	PH3	150	0.3	120.0	120	120.0
Phosgene	COC12	125	1.25	120.0	120	120.0
Nitrogen Dioxide	NO2	100	25/1*	21.6	41.2	11.2
Hydrogen Cyanide	HCN	470	5**	120.0	120	120.0

CBRN Air-Purifying Escape Respirator Concepts – Benchmark Testing

	Manufacturer's Model	Challege Concentration	End Point Concentration	Manufacturer C		
Flow/Humidity				64/25	64/80	100/50
Cyclohexane	C6H12	1300	10	26.8	17.7	13.3
	C6H12	2600	10	14.0	10.5	7.3
Sulfur Dioxide	SO2	750	5	17.8	24.6	9.7
	SO2	1500	5	8.8	10.0	4.0
Ammonia	NH3	1250	12.5	16.0	19.2	9.4
Formaldehyde	CH2O	250	1	52.9	32.9	16.6
	CH2O	500	1	36.3	24.8	11.3
Hydrogen Sulfide	H2S	500	5	0.0	0.0	0.0
Cyanogen Chloride	CK	150	2	0.0	0.0	0.0
Phosphine	PH3	150	0.3	0.0	0.0	0.0
Phosgene	COC12	125	1.25	0.0	0.0	0.0
Nitrogen Dioxide	NO2	100	25/1*	0.0	0.0	0.0
Hydrogen Cyanide	HCN	470	5**	0.0	0.0	0.0

Benchmark Testing – High Concentrations



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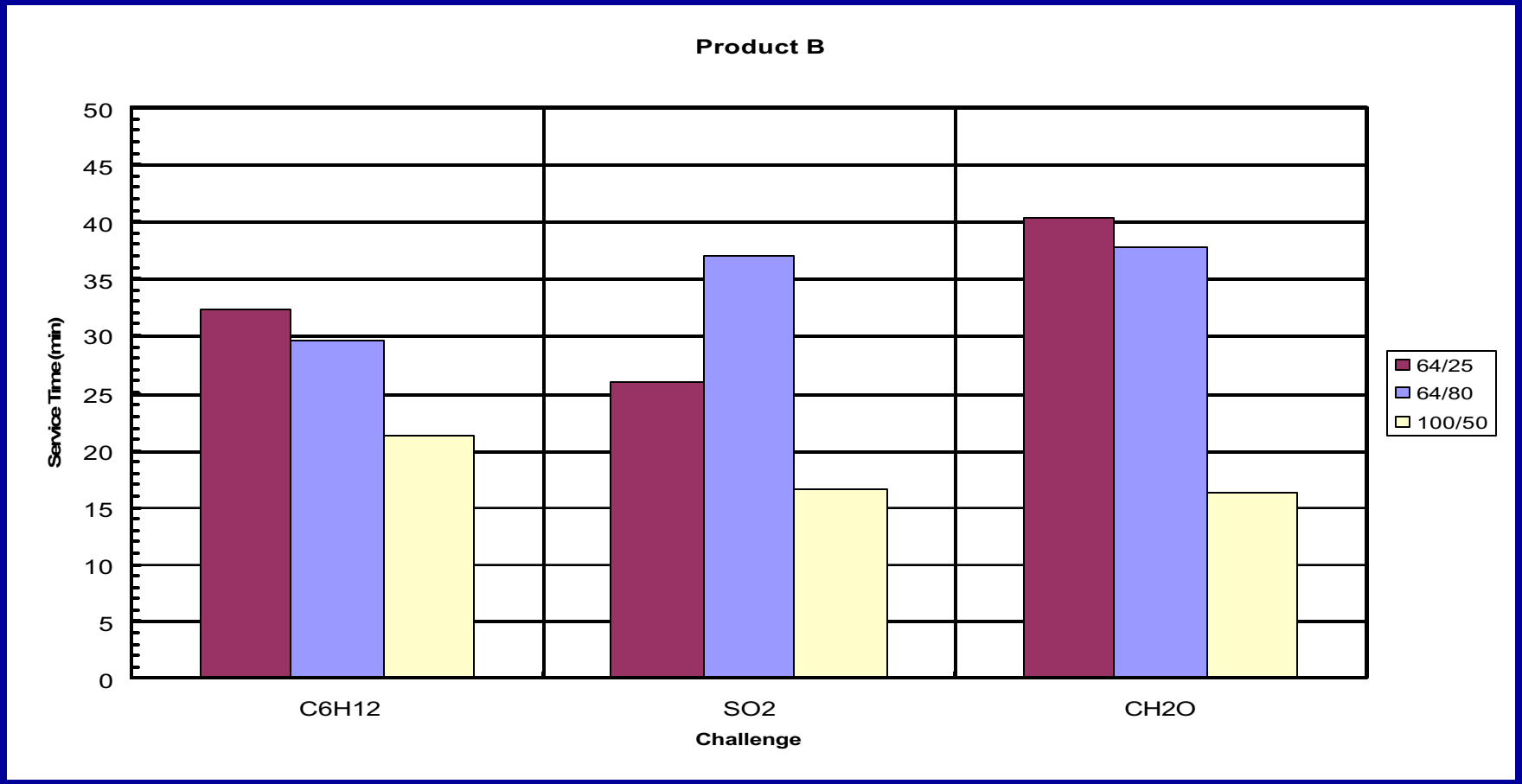
Benchmark Testing – High Concentrations



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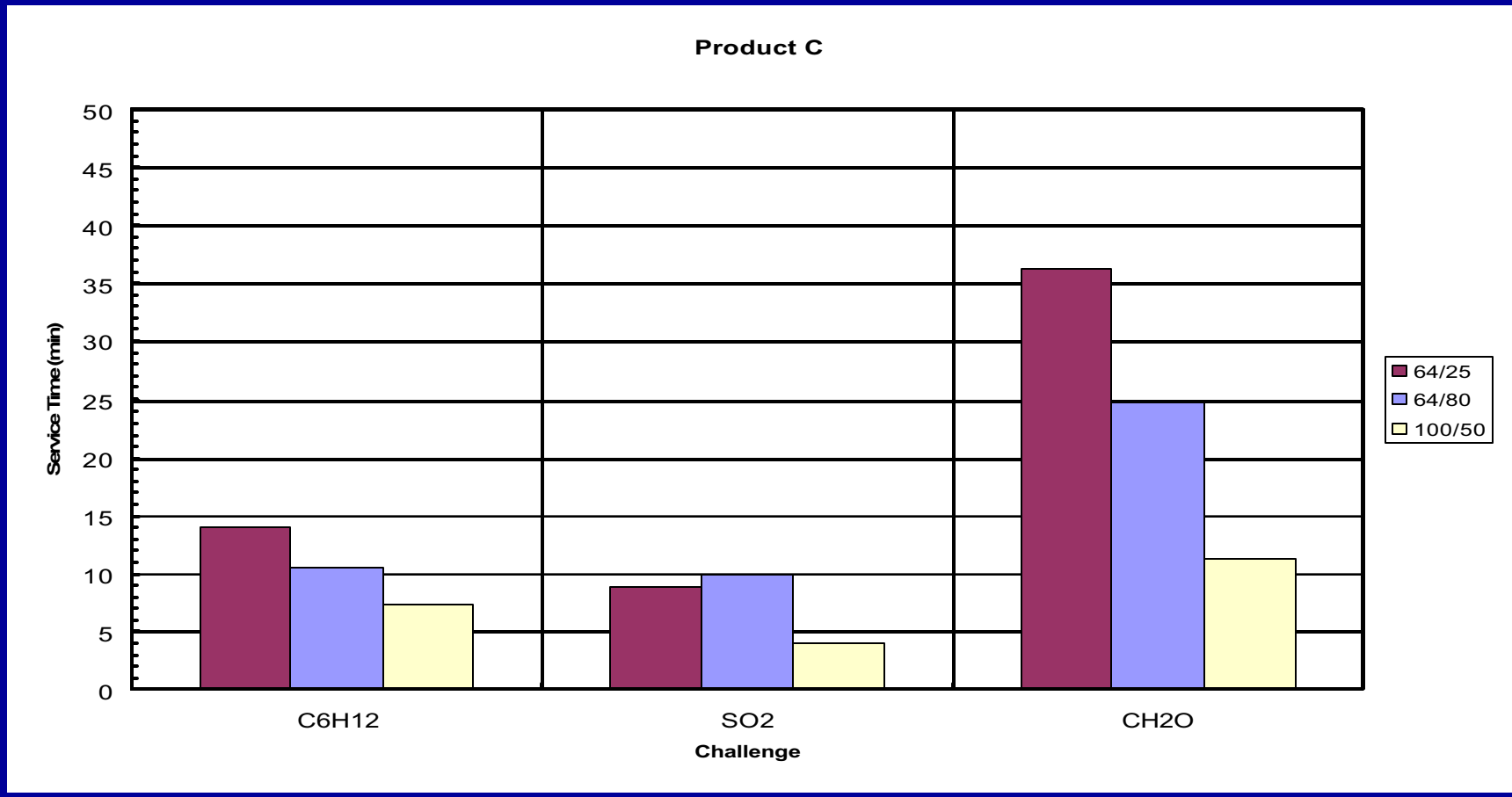
Benchmark Testing – High Concentrations



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